

Applied Statistics:
Experience & Certification in Quality Assurance

A Senior Project
presented to
the Faculty of the Statistics Department,
California Polytechnic State University, San Luis Obispo

In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science
in
Statistics

by
Huey D. Dodson
February, 2010

© 2010 Huey Dodson

Table of Contents

Senior Project Abstract.....	3
Part I: The Internship.....	4
An Introduction to River Ranch Fresh Foods.....	4
How I Became Involved	4
Responsibilities & Expectations.....	5
Projects.....	6
Project Summaries	7
Project 1: Tegra Sorting Efficiency	8
Project 2: Tegra Shaker #2 Sorting Efficiency.....	10
Project 3: Film Waste	11
Project 4: Change Over Time.....	12
Project 5: Leakers	16
Project 6: Carton Waste	18
Project 7: Receipt to Storage Time.....	19
Project 8: Blends Analysis.....	21
Project 9: Clean-up Waste & Spill Point Losses.....	24
Project 10: Actual vs. Standard Yields	27
Project 11: Cull Truck	29
Project 12: Consumption Rates.....	30
Part II ASQ Quality Process Analyst Certification	31
An Introduction to The American Society for Quality.....	31
Certified Quality Process Analyst	31
CQPA Body of Knowledge.....	32
Quality Basics	32
Problem Solving and Improvement	33
Data Analysis	33
Customer-Supplier Relations.....	35
Test Preparation	36
Examination & Results.....	37
ASQ CQPA Press Release	37
Appendix	38

SENIOR PROJECT ABSTRACT

The composition of my senior project can be broken down into two parts. The first part of my project, without which the second could not be pursued, involved a 13 week internship at a produce processing facility where I took part in several projects varying in scope and type. The second part was to acquire certification as a Quality Process Analyst from the American Society for Quality.

This document is structured to represent the dichotomous nature of my project; the first section is dedicated to my internship experience, and the second dedicated to the certification examination preparation and completion.

Part I: The Internship

An Introduction to River Ranch Fresh Foods

River Ranch Fresh Foods, LLC. (hereto referred to as RRFF) is a produce processing company based in my home town of Salinas, California. The company specializes in the processing of various types of produce (i.e. spinach, several types of lettuce, carrots, broccoli, etc.) More specifically, RRFF takes in raw produce from the produce growers and outputs various value-added, store-ready, clean, cut, and packaged products.

The company has two bases of operation: El Centro, CA and Salinas, CA. One base operates during one part of the year and the other base operates in the remaining part. All of my work was performed at the Salinas plant.

How I Became Involved

In the early months of 2009 I grew interested in the application of statistics called quality assurance. After learning theoretical methods of implementing statistical tools to monitor and ensure quality, I wanted to get a sense of what it was like to implement these techniques in the real world. Having grown up in Salinas I was aware of the fact that RRFF was a company with large enough of output to require a quality assurance system of some sort.

With this in mind, I made efforts to contact and eventually set up an interview with the Director of Quality Control at RRFF. Sometime after our phone interview I received an email proposing a possible summer research internship opportunity. After some back and forth correspondence, we eventually set up an interview for the summer internship position.

Responsibilities & Expectations

Before I began the actual work, my understanding of the company's expectations of my work was the following:

- Identify factors that contribute to wasted product.
- Design sampling methods.
- Manipulate these factors to minimize waste and optimize efficiency.
- Collect data.
- Analyze collected data, and present findings and conclusions.

As I began my work, I realized my initial understanding was naïve in terms of the complexity and labor required to deliver what I thought the company wanted. Instead of one large intensive project, I encountered a diverse number of smaller projects addressing different aspects of production. This was interesting because I had the opportunity to learn about many different components of the company while also being able to refine my data collection techniques.

I was fortunate enough to have a dedicated work space where I could do my work and think. It was extremely motivating to have a base to work out of. In this workspace I had several resources:

- A computer with internet and company intranet. I had access to useful company information such as: building layout diagrams, quality assurance system info, and various continuously updated production information.
- Safety equipment: goggles, helmet, jacket, and earplugs etc.
- Data collection tools: Writing utensils, clipboards, printers, stopwatches, etc.
- I was also able to request help of employees if it didn't interfere with production.

There were several adjustments I had to make to get used to working in the RRFF environment, the most prominent being a sort of "one man team." In each project I was told what information was desired, and was given pointers on how to go about gathering it. A reoccurring theme seemed to be

“Now how am I supposed to gather *this* data?” One misunderstanding I had was the presence of automated data collection apparatuses. There were several occasions where I thought an automated data collection device would have been present but wasn’t. This meant that the burden of collecting data was larger than anticipated most of the time. The point being I learned that it was very hard to design, implement, manage, and analyze a study on a process I was still trying to understand.

Due to the personnel structure of RRFF, it was imperative that anyone collaborating with the workers in the plant would have to be able to communicate effectively in Spanish. Though I had already had a lot of Spanish speaking experience, this was still somewhat of a challenge throughout the whole internship.

Projects

The following pages describe in detail the various projects I attempted. Some are more complex and richer than others based on the project importance, as seen by the company, and accessibility in terms of data gathering.

The next page has a table that gives a brief summary for each project I conducted.

Project Summaries

In Chronological Order

Project	Description
Tegra Sorting Efficiency	A machine called "Tegra" sorts through a large amount of spinach at a high rate of speed. The goal was to determine efficacy and efficiency. In other words, whether or not the machine rejected bad product and how much of the rejected product was bad.
Shaker #2 Efficiency	Shaker #2 refers to a component of the production line that shakes bunches of spinach to filter out small unusable bits of spinach and small foreign objects. I noticed that a large amount of the discharge from this filtering component was good product. The goal of this project was to determine how much good product was being wasted and why.
Film Waste	At the end of each production line there is a bagging station where produce gets bagged and boxed. The machines that bag the produce need to be calibrated every time certain changes occur, in this calibration process, a notable amount of plastic bags are wasted. The goal was to categorize and quantify wasted bagging film.
Total Raw Product Waste (Cull Truck)	Virtually all raw product waste eventually finds it's way to a 30' tall waste shoot. This waste shoot dumps the product waste into a dump truck. The goal of this project was to obtain daily raw product waste totals by weighing the truck each time it went to the dump. Knowing the total raw product waste could help cross check yield calculations.
Change Over Time	Bagging and boxing of product happens at a very fast pace, and necessarily so. When this process is interrupted for even a short period of time, production potential is compromised. The goal of this project was to categorize and quantify the time that the bagging/boxing process was interrupted.
Leakers	Certain products are required to be put in a bag that is sealed air tight to maintain freshness and quality. To test the seal, bags are put into a water filled vacuum chamber for inspection. There is already quality control personnel assigned to regularly inspect this, however the goal of this project was to conduct a more thorough survey to quantify and categorize leaky bags.
Carton Waste	Cardboard boxes, referred to as Cartons, are used to transport finished product wherever they're destined. At many points in the plant cartons are thrown away for many different reasons. Though individually they're inexpensive, the cost adds up quickly. The goal of this project was to categorize and quantify the wasted cartons.
Receipt-to-Storage times	The produce comes to the plant on large hauling trucks. The process that takes the raw product off of the delivery truck and into a cold room for storage has a couple of stages. Knowing how much time each stage within the process takes, as well as the total process time, is valuable information for assessing production capacity.
Blend Analysis	Some of the finished products the plant outputs are mixtures. Ensuring the proper mixture is obtained helps with yield calculations, product accountability, and quality assurance. The goal of this project was to determine the proximity to the target blend for various mixed products. (i.e. unmixing salad!)
Actual Yields	Of major importance is the amount of finished product the plant yields given a starting amount of input product. The goal of this project was to put known amounts of product onto the line and observe the amount actually yielded.
Consumption Rates	Each production line has different characteristics in terms of what type of product gets input, what product gets output, and the various tasks performed on the line. The goal of this project was to get an estimate of the rate of raw product consumption for each line.

Table 1

Project 1: Tegra Sorting Efficiency

Goal: To measure the amount of product the Tegra sorting machine rejects and to measure how much of this waste is defective product (discoloration) or foreign objects.

Sampling Method: Spinach was poured onto the production line (regular) two bins at a time. A single observation consisted of collecting all of the rejected product from one pour.

Variables:

1. Amount of rejected product measured in pounds.
2. Cleaning in process (CIP) recorded as Yes or No.
 - This variable indicates whether or not the Tegra machine was cleaning itself (camera window, lights, air ducts, etc.) while it was sorting product.
3. Amount of defective product/ foreign objects in the rejected product measured in pounds.

Summary of Findings:

During the process of collecting the rejected product, I observed that at certain points in the sorting process the machine would reject a very large amount of product for a few seconds, and then return to a steadier rate of rejection. After speaking to a few of the crew members, I learned that when the machine is cleaning itself while sorting product, it tends to reject significantly more product than when not.

Out of the 16 observations, I sorted through 7 of them to measure how much of the rejected product was defective/foreign. The average percentage of defective leaves/foreign material in the total rejected product was about 2.6%. In addition to discolored/defective leaves, foreign objects such as a rubber band, moths, and bits of dirt were found in the rejected product.

CIP (Yes or No)	Average amount of rejected product (lbs.)	95% CI for Average	Minimum Observed	Maximum Observed	Average % Defective/ Foreign	Number observed in sample
Yes	6.45 lbs	(4.93 lbs, 7.99 lbs)	3.52 lbs	10.10 lbs	*	9
No	1.61 lbs	(1.25 lbs, 1.94 lbs)	1.61 lbs	2.35 lbs	2.6%	7
Table 2						16

* The observations made while the machine was cleaning itself were too large to sort through in a reasonable span of time.

Confidence Interval Interpretation:

We can be 95% confident that the Tegra machine rejects between 4.93 lbs and 7.99 lbs of spinach on average when the machine cleans itself during a pour.

Furthermore, we can be 95% confident that the Tegra machine rejects between 1.25 lbs and 1.94 lbs of spinach on average when the machine does not clean itself during a pour.

Notes/Suggestions:

There are a few factors I noticed that I believe contribute to an increase in the amount of product the Tegra rejects.

- Camera Calibration/ Normalization - Recalibrate the camera to adjust to subtle lighting and environmental conditions.
- Software Calibration – Small changes in the color recognition settings can potentially have a large affect on the amount of product the Tegra rejects.
- CIP- When the machine cleans itself while sorting, it tends to reject a large amount of product unnecessarily. Making the machine clean itself when it is not sorting would save good product from being rejected.

When the Tegra machine sorts product, and does not clean itself during the process, it tends to reject about 1.61 lbs of product. On average, 2.6% of this rejected product consists of defective leaves or foreign objects, and the rest is good product. So on average, for every two bins of spinach poured into the Tegra sorting machine rejects about 1.57 pounds of good product. For perspective, this means that on a day where the Tegra sorts through 140 bins of spinach, it is likely that it would reject about 109 lbs of good product.

However, this projection is valid only if the machine never cleans itself while sorting. About half of the runs I observed the Tegra cleaned itself during the process. Assuming this is always the case, on the same day as described above the Tegra would reject about 280lbs of good product.

Project 2: Tegra Shaker #2 Sorting Efficiency

Goal: To measure the amount of product the 2nd shaker rejects and to measure how much of this waste is defective product (small pieces or partial leaves).

Sampling Method: Spinach was poured onto the production line (regular) two bins at a time. A single observation consisted of collecting all of the rejected product from one pour.

Variables:

1. Amount of rejected product measured in kilograms.
2. Costco Spinach or not: Yes or No.
 - This variable indicates whether or not the product being filtered was intended for Costco.
3. Amount of defective in the rejected product measured in kilograms.

Summary of Findings:

While collecting samples for the Tegra sorting machine project, I noticed a lot of good product falling out from the 2nd spinach shaker. So I took a sample of this waste to see how much of it was defective.

Below is a table describing what was found:

Average Spinach Rejected (lbs.)	Average Defective Product (lbs.)	Costco	Ave. Percent Defective	Number Observed
5.77	*	Yes	*	3
2.07	0.04	No	2.04%	5
Total				8

Table 3

* The observations made when Costco product was run were too large to sort through in a reasonable span of time.

As I was collecting the samples for this study I tried to determine why exactly so much good product was falling out. I noticed that while the majority of the product was traveling over the grate that was meant to cipher out small pieces, some product was falling through the gaps on each side of the grate. In my opinion this was where the most of the waste was coming from.

Project 3: Film Waste

Goal: To quantify and categorize the wasted film from the product bagging process.

Sampling Method: Each day either 1 or 2 shifts are performed in the plant. The observational unit consisted of collecting waste coming from a single shift. On each bag there is printed information describing which space the product was bagged at, I used this to sort through the collected waste. Care was taken to make sure product was completely removed from bags in the cases of “Re-Work”.

Variables:

1. Space number - There are many bagging stations (spaces) with different characteristics.
2. Type - There were two main types of film waste:
 - Film wasted from the calibration of the bagging machine (“Change Over”).
 - Film wasted due to unsatisfactory seal (“Re-Work”).
3. Amount of film waste measured in pounds.

Summary of Findings:

The data used to make the table below was collected from two ten hour shifts.

Table 4

Space →	1	2	3	4	5	6	
Re-Work (%)	60.2%	45.3%	58.3%	71.7%	34.5%	69.1%	56.5%
Change Over (%)	39.8%	55.7%	41.7%	28.3%	65.5%	30.9%	43.7%
Total (lbs)	23.6	30	18	20.5	20	57.2	169.3

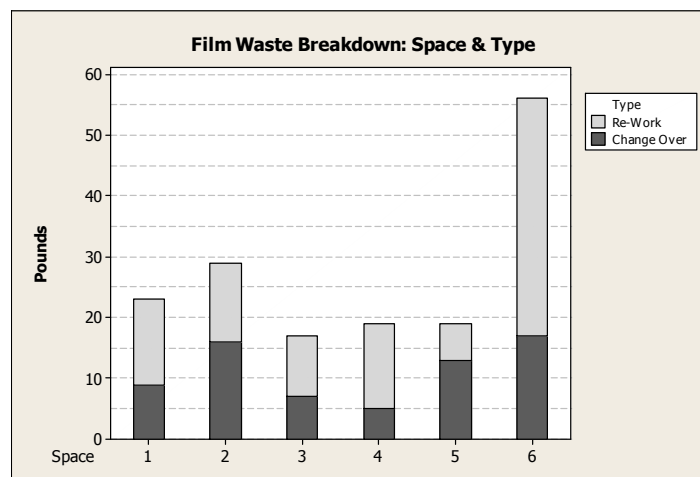


Figure 1

Notes/Suggestions:

There are a few factors I noticed that I believe contribute to film waste:

- Frequency of Film Change - Changing film for product changes, item changes, or film refilling results in recalibration, which involves re-working more bags in the process.
- Product Type - I believe that different product variants have different tendencies of pieces getting trapped in the seal, thus more bags being rejected by the boxing personnel to be re-worked.

Project 4: Change Over Time

Goal: To quantify and categorize the time when bagging spaces were stopped.

Sampling Method: For spans of time I would walk around the bagging spaces and watch for times when a bagging station stopped. When I noticed a station stopped I recorded which station it was, when the station stopped, for what reason, and when it began again.

Variables:

1. Space number - There are many bagging stations (spaces) with different characteristics.
2. Side - Some bagging stations have two bagging mechanisms, one is called the “A” side and the other “B”.
3. Reason for Stop - There were various reasons why a bagging station would stop, these are the ones I was told would occur most (not listed in any particular order):
 - *Box Change*: Sometimes different boxes would need to be used for the same bag type. This would halt the bagging process.
 - *Film Change* or “Change Over”: The film used to make the bags comes on rolls which are fed into the machine. When these rolls are empty they are changed, which stops the process.
 - *Tube Change*: When a bagging station switches to a larger bag, the “tube” that forms the bag needs to be changed, this halts the bagging process.
 - *Product Change*: When a station is designated to bag a different product, the production line feeding that bagging station is cleaned to avoid cross contamination and assure product quality. This cleaning process stops the bagging process for a considerable amount of time.
 - *Label Issues*: When the boxes are packed with bags, the boxes get stamped with a paper label. These labels malfunction and/or run out and need to be attended to. Adjusting the labeling machine sometimes halts the bagging process.
 - *No Product*: At times the bagging stations have to wait on the production line to output product. When there is nothing to bag, the bagging process stops.
 - *Problem*: The bagging machines are complicated, multifaceted machines that aren’t always easy to diagnose. When certain problems arise, repairs are made as fast as possible. Some problems that occur halt the bagging process.
 - *Other*: Due to my inexperience and limited resource, I was unable to capture exactly why a bagging station stopped in every occasion. When I was unable to obtain the reason for a stop in a reasonable manner, I recorded the reason as “Other”.
4. Start - When the bagging process was interrupted.
5. End - When the bagging process resumed.
6. Notes.

Summary of Findings:

I made observations on 16 bagging spaces. Some bagging stations I spent more time observing than others.

- Spaces 1-6: Approx. 6hrs. 20min. observed
- Spaces 7-10: Approx. 3hrs. 20min. observed
- Spaces 11-16: Approx. 2hrs. 30min. observed

In an effort to account for the different times spent observing different spaces I used “percentage of total observation time” as a variable to compare spaces with one another. Below are graphics to describe what was found.

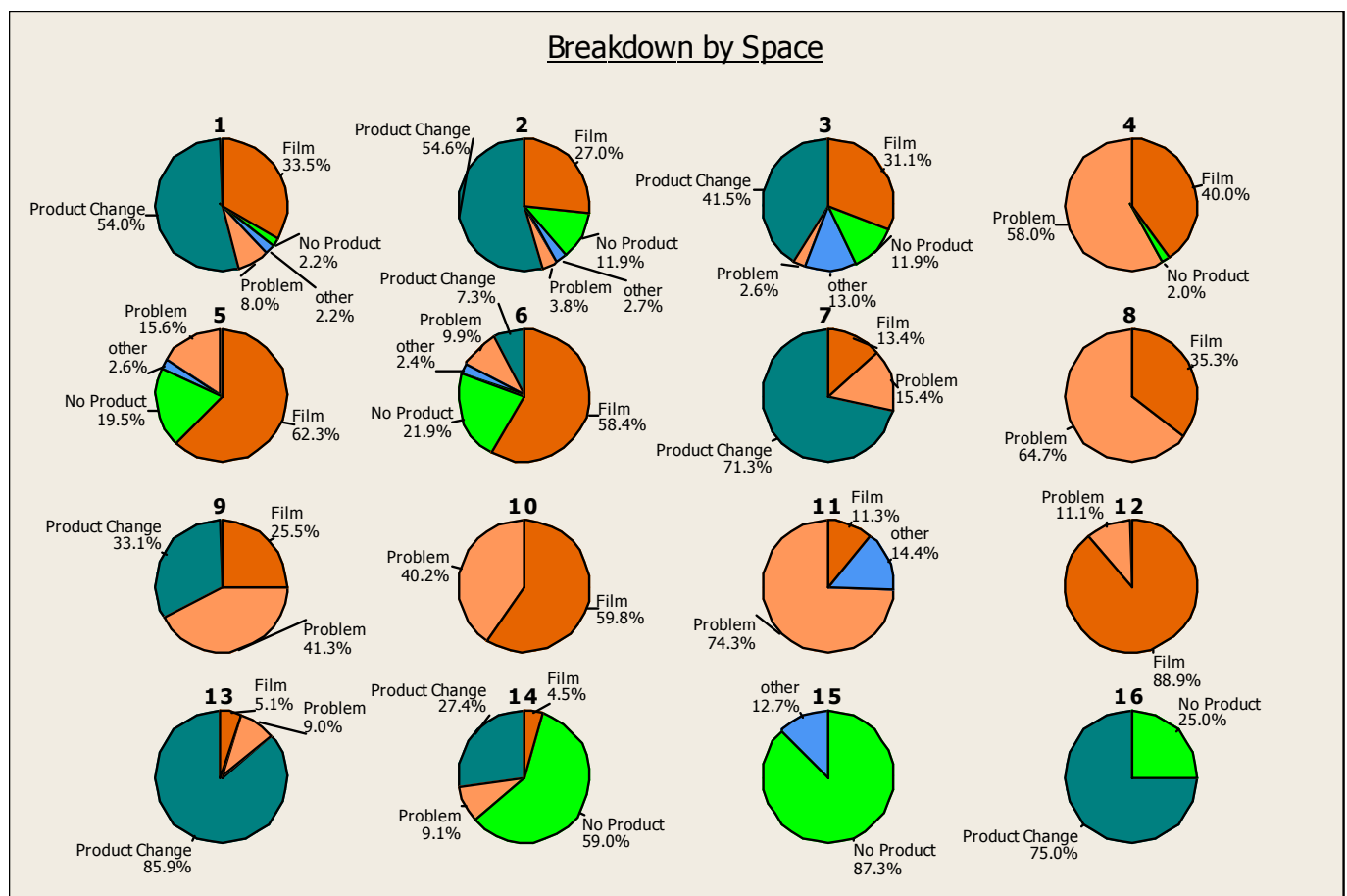


Figure 2

Interestingly, not all spaces have similar compositions. This was to be expected because certain spaces are dedicated to certain product and other spaces are more variable.

Below we can see which spaces are down more often than others and for what reason.

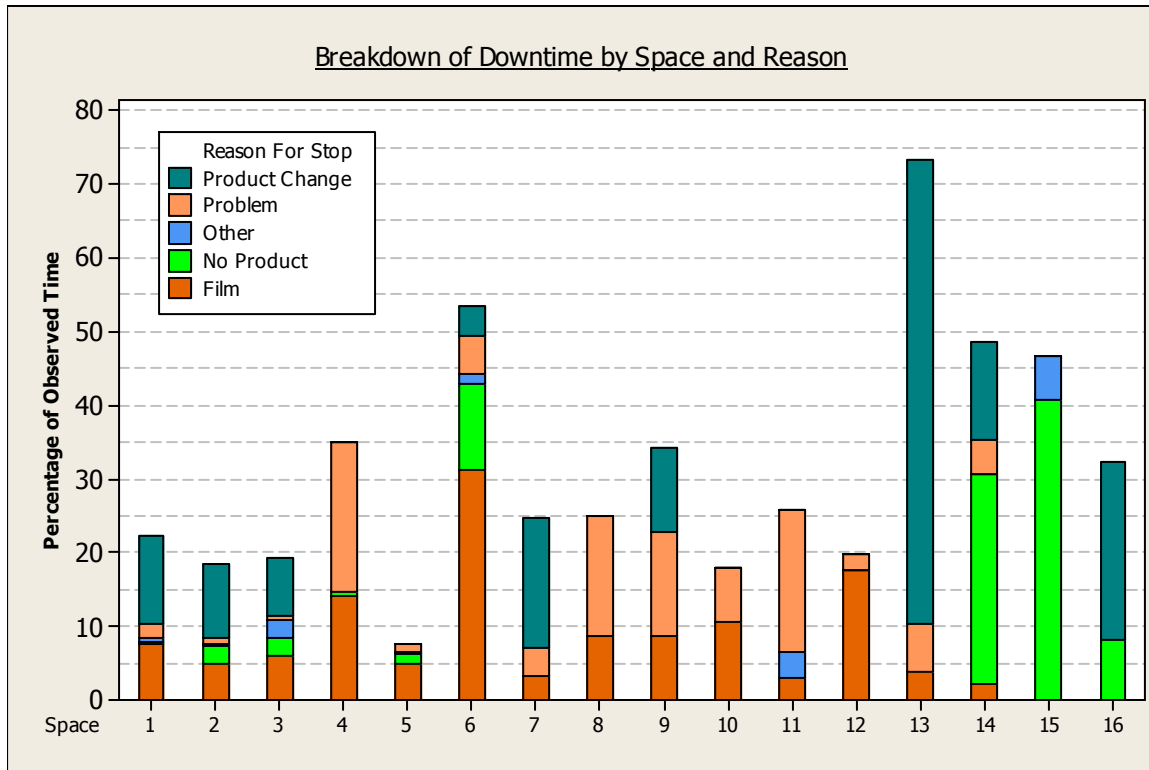


Figure 3

We can see that spaces 6 and 13 were down for a large percentage of the duration of observation time, but for different reasons. Space 6 looks to have been down mostly due to film changes, where space 13 was down due to a change in product. We can also see that spaces 4, 8, 9, and 11 seem to have a large percentage of their down time due to problems with the bagging machines.

The table below shows how long, on average, the bagging process is stopped for each type of interruption:

Table 4

Reason	Average Downtime (min.)	Minimum (min.)	Maximum (min.)	95% Confidence Interval (min.)
Film	7.02	2	24	(5.88, 8.16)
No Product	9.42	1	52	(2.58, 16.26)
Other	3.67	1	6	(2.34, 5.00)
Problem	6.33	1	42	(3.57, 9.10)
Product Change	23.36	15	45	(17.91, 28.81)

Confidence Interval Interpretation

Using “Film” as an example, we can say with 95% confidence that the average time the bagging process stops due to film change is between 5.88 and 8.16 minutes.

When I was recording the data for this project, it began to interest me to know how much of the time the bagging spaces had was being used, how close to the time capacity was being used. I calculated that in the time that I was recording the change over times, the bagging spaces had a cumulative time capacity of about 65.3 hours, and of this time about 19.3 hours were unused. This meant that about 29.5% of the time available was unused.

{ 15 }

Project 5: Leakers

Goal: To conduct a survey in order to determine the rate of insufficiently sealed bags output from each bagging station at the end of the production line.

Sampling Method: The observational unit consisted of ten bags from a given bagging space. I randomly (to the best of my ability and given the situation) selected samples of groups of ten bags from each of the bagging spaces.

Variables:

1. Space Number - It was expected that certain spaces had more “leakers” than others, so space number was recorded.
2. Side - Some of the bagging machines had two sides, independent with respect to sealing, one side could have a leaking problem and the other could not. Thus, keeping track of which side a bag came from was recorded.
3. Item Number - Item numbers carry a lot of information in company data bases that could correlate to increases in leaky bags. If a certain item number can be found to yield more leakers than other item numbers, then we can trace that item to information about the bag that could be causing frequent leaking.
4. Time - This variable refers to the time stamped on the bag indicating when the bag was constructed, filled, and sealed. Knowing this stamped time helps to trace bags coming from that same machine at that same time if the bags tested leak.
5. Leakers - This variable is the number of leaky bags out of ten that were observed.

Summary of Findings:

Due to the fact that different size bags require different vacuum chamber settings, special care had to be taken not to overstress or under stress bags to avoid biased, and hazardous, results. Below is a basic summary of what was found:

Table 5

08/21/09- 08/28/09			
Space	Total	Leakers	Percentage
1	430	8	1.86%
2	420	10	2.38%
3	470	8	1.70%
4A	360	7	1.94%
4B	360	2	0.56%
Total Bags Tested	Leaky Bags Found	Percent Leaky Bags	
2040	35	1.72%	

Table 1 shows results during a specified period of time when I focused only on spaces 1-4.

Table 6

All Observations				Total Bags Tested	Leaky Bags Found	Percent Leaky Bags
Space	Total	Leakers	Percentage			
1	470	8	1.70%	2890	64	2.21%
2	470	10	2.13%			
3	520	8	1.54%			
4A	430	7	1.63%			
4B	430	2	0.47%			
5A	70	0	0.00%			
5B	70	2	2.86%			
6A	90	7	7.78%			
6B	110	11	10.00%			
7	70	1	1.43%			
9	80	4	5.00%			
10	80	4	5.00%			

Table 6 shows results including all observations.

Notes/Suggestions:

I had a lot of time to think about the leaky bag problem during the observation period, and these are things I noticed/ wanted to point out:

- For 5 lb. Shredded Lettuce & Cabbage, the correct water level (5.5 inches) and vacuum pressure (23 in. Hg) raises the water level into the vacuum tube and does not allow the vacuum to exceed about 20 in. Hg.
- Increasing the frequency of testing bags for leakers isn't necessarily the best solution. Based on the assumption that the Hayssen bagging machines are robust, consistent, and precise, it would be more effective to control for the factors we know to induce leakers such as
 - Changing tubes
 - Changing film
 - Changing product
 - Changing operators
 - Long pauses / interruptions in bagging process
 - Etc.
- If these factors are uncontrollable, then a higher testing frequency would indeed catch more leaky bags. However, as it is right now, there are 3 Pack-Vac stations and 3-4 QA technicians checking, amongst other things, for leaky bags. When I was dedicated to only checking for leakers I sometimes had to wait for a station to free up, and was in the way of the technicians much of the time.
- Leaks can occur to bags after they have been boxed and out of the plant, via shipping & handling. Customer care of the bags could also cause post-delivery leaks.

Project 6: Carton Waste

Goal: To quantify, categorize, and assess the cost of the cardboard carton waste the plant produces.

Sampling Method: After every shift a worker sorted through the cardboard bins and documented how many of each type of cardboard box was thrown away during that shift.

Variables:

1. Item Number: Knowing the item number enables us to retrieve the cost of a box of that type.
2. Carton Defect - Cartons are thrown away for a variety of reasons, these being the most common:
 - *Damp*: The carton too damp to be safely used.
 - *Water Damage*: The carton was saturated with water in some area.
 - *Discoloration*: The carton was sun damaged/ faded to badly to be usable.
 - *Minor Maxco Defect*: The carton was damaged in the auto-assembly process.
 - *Major Maxco Defect*: The carton was severely damaged in the auto-assembly process.
 - *Insufficient Glue*: Glue was not affectively applied onto the carton and was unusable.
 - *Rework*: The carton was previously used to hold product that had to be reprocessed and the carton could not be reused.
 - *Factory Damage*: The carton was delivered to the plant in a condition that was unusable.
 - *Good*: The carton had no defect/ reason to be thrown away.
3. Count: How many of each type, and of each defect, was observed after a shift.

Summary of Findings: Below is a comparison between the Salinas and El Centro plants carton waste broken down by Defect.

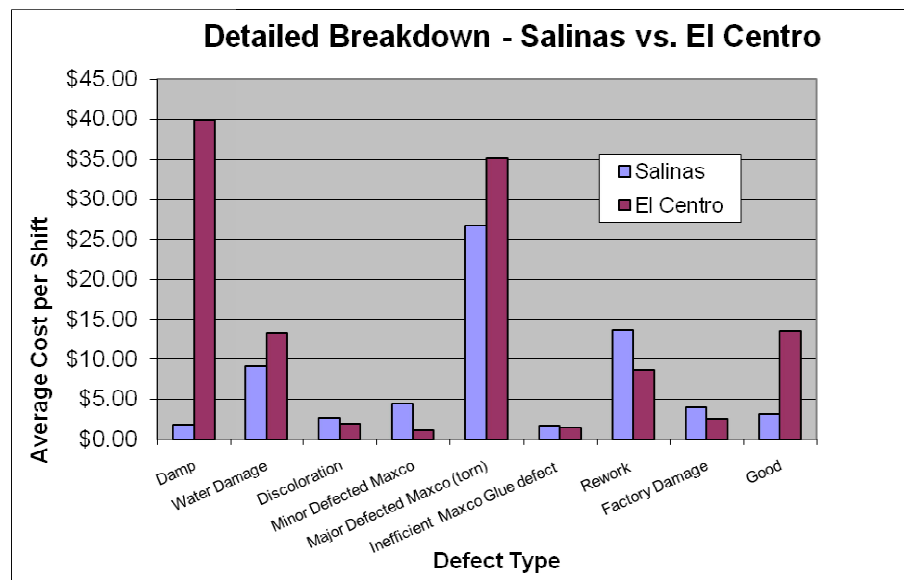


Figure 5

It can be seen that El Centro seems to produce more carton waste than Salinas. Also, major defects induced by the box assembly machine (Maxco) is the most expensive of defect types.

Project 7: Receipt to Storage Time

Goal: Quantify the amount of time, on average, bins of product sit in the receiving yard before they are stored in the refrigerated warehouses.

Sampling Method: For a few days I stood and recorded information from bins of product that came from the vacuum cooling tubes on their way to the warehouses and timed, for each bin, how long the trip took.

Variables:

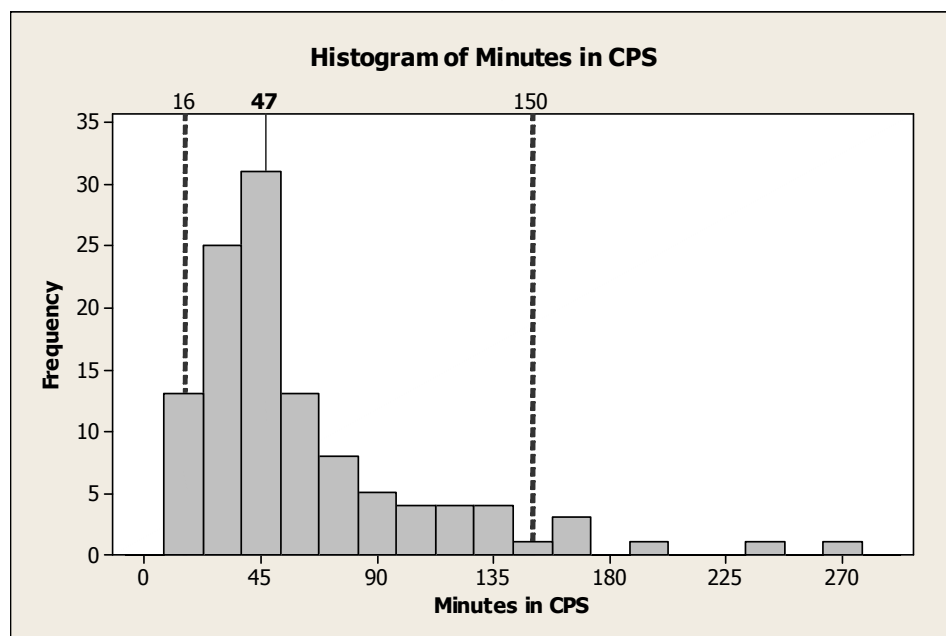
1. Lot Number - This number links any given bin to a database that contains information that is related to the lot in any way, such as the time it was received off of the truck on which it came to the plant and entered a vacuum tube.
2. Number of Bins - This is the number of bins that came out of a vacuum tube at some given time.
3. Receipt Time - What time the product came off of the delivery truck.
4. Vacuum Start Time - At what time the vacuum cooling tube began.
5. Vacuum Finish Time - At what time the vacuum cooling tube finished.
6. Final Destination Time - At what time the bin of product reached a cold room.

Summary of Findings:

When the product is taken from the delivery trucks to cooling pre-stage area (CPS), from the CPS to the tubes, and from the tubes to the cold room pre-stage area (CRPS), it is done by a very large forklift that can carry up to 48 bins at a time. Thus, all the bins in a given lot will have the same journey and sitting times up to the CPRS. However, when the product is taken from the CPRS to a cold room, it is taken by a smaller forklift that carries four bins at a time. Thus, more variability occurs within lots of bins at this stage than at the others.

So there were two stages of interest where the product sat in the yard; the CPS and the CPRS. Below are summary graphics which display the results.

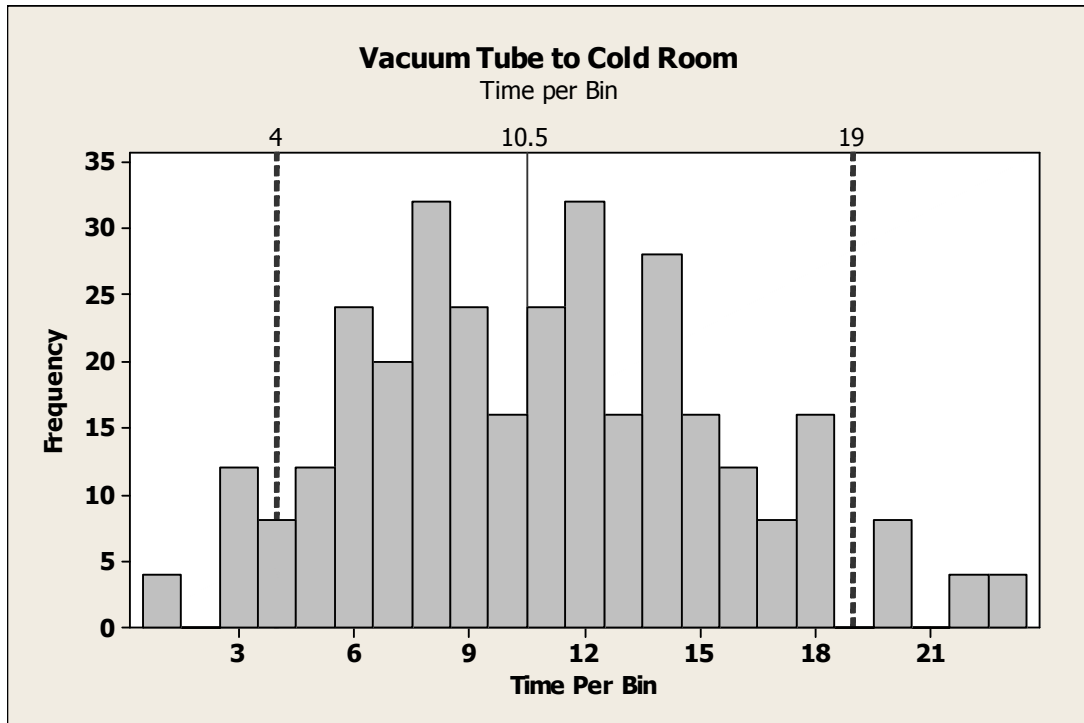
Figure 6



Median time between Receipt and Vacuum Tube: 47 minutes

90% of the bins observed waited between 16 minutes and 150 minutes to enter the Vacuum.

Figure 7



Average time between Vacuum Tube and Cold Room: 10.5 minutes

90% of the bins observed waited between 4 minutes and 19 minutes to enter the Cold Room.

Project 8: Blends Analysis

Goal: To verify that the actual blend proportions for various salad types being produced was close to the target standard blend proportions.

Sampling Method: I took a random sample of 15 bags being produced in a day. Separating components of a salad with any sort of accuracy is a long process. For this reason it was difficult to obtain a large sample size.

Variables:

1. Ingredient - Different salad blends have different components, this specified which was being measured (e.g. Iceberg, Romaine, Green Leaf, etc.).
2. Actual Percentage - Of the total weight of the product in the bag, this was the actual percentage of a given ingredient.
3. Space Number - This is the bagging station that a bag came from.

Summary of Findings:

For the European Blend, Garden Salad, and Broccoli & Carrots blends I've displayed averages (as I looked at more than one of these blends). On the next page are table summaries for the bags I sorted through. Below is the percentage each type of produce was off, given all of the different blends in which it was included:

Table 7

Iceberg	-3.4%
Romaine	5.0%
Red Cabbage	2.0%
Green Leaf	-17.0%
Carrots	1.4%
Broccoli	-4.4%
Radicchio	0.0%
Endive	-3.0%
Snap Pea	4.3%

To make sense of the table, take Iceberg for example, it says that iceberg was, on average, 3.4 percentage points under the target percentage it was supposed to be, considering at all of the blends it was a component of.

Bag Composition: All weights are in pounds.

Tables 8a. – 8i

Salad Mix w/ Romaine				
Ingredient	Actual Weight	Actual Percentage	Spec	Percent Difference
Iceberg	0.756	66.3%	70.0%	-3.7%
Romaine	0.055	4.8%	15.0%	-10.2%
Carrot	0.228	20.0%	9.0%	11.0%
Red Cabbage	0.101	8.9%	6.0%	2.9%

Garden Salad				
Ingredient	Actual Weight	Actual Percentage	Spec	Percent Difference
Iceberg	1.056	83.2%	85.0%	-1.8%
Carrots	0.100	8.5%	9.0%	-0.5%
Red Cabbage	0.103	8.3%	6.0%	2.3%

Iceberg Blend				
Ingredient	Actual Weight	Actual Percentage	Spec	Percent Difference
Iceberg	0.243	43.3%	40.0%	3.3%
Romaine	0.204	36.4%	25.0%	11.4%
Green Leaf	0.045	8.0%	25.0%	-17.0%
Carrots	0.069	12.3%	10.0%	2.3%

European Blend				
Ingredient	Actual Weight	Actual Percentage	Spec	Percent Difference
Iceberg	0.323	47.4%	60.0%	-12.6%
Romaine	0.279	39.7%	20.0%	19.7%
Radicchio	0.051	7.5%	10.0%	-2.5%
Endive	0.038	5.4%	10.0%	-4.6%

Stir Fry Medley				
Ingredient	Actual Weight	Actual Percentage	Spec	Percent Difference
Broccoli	0.452	58.6%	55.0%	3.6%
Carrot	0.17	22.0%	30.0%	-8.0%
Snap Pea	0.149	19.3%	15.0%	4.3%

Broccoli & Carrots				
Ingredient	Actual Weight	Actual Percentage	Spec	Percent Difference
Broccoli	0.398	51.6%	60.0%	-8.4%
Carrot	0.373	48.4%	40.0%	8.4%

Salad Mix				
Ingredient	Actual Wieght	Actual Percentage	Spec	Percent Difference
Iceberg	1.12	86.0%	85.0%	1.0%
Carrot	0.096	7.4%	9.0%	-1.6%
Red Cabbage	0.087	6.7%	6.0%	0.7%

Italian Blend				
Ingredient	Actual Wieght	Actual Percentage	Spec	Percent Difference
Romaine	0.471	75.8%	80.0%	-4.2%
Radicchio	0.093	15.0%	10.0%	5.0%
Endive	0.057	9.2%	10.0%	-0.8%

Romaine Garden Salad				
Ingredient	Actual Wieght	Actual Percentage	Spec	Percent Difference
Romaine	0.533	84.9%	85.0%	-0.1%
Carrots	0.052	8.3%	9.0%	-0.7%
Red Cabbage	0.043	6.8%	6.0%	0.8%

Project 9: Clean-up Waste & Spill Point Losses

Goal: To locate points in the production line where product spills, and to measure how much waste comes from cleaning up this waste.

Sampling Method: Each day for about 4-5 bins were set up to collect waste from different sections in the Salad Room. After a given period of time I weighed each of these bins and recorded how long they'd been collecting waste.

Variables:

1. Section - Which section/designation a bin had.
2. Working Hours - For how many hours, excluding breaks/lunch, the bin collected waste.
3. Weight - How much the bin weighed.

Summary of Findings:

Day to day the hours of observation changed, some days the bins collected 9 hours of waste and other days the bins collected 5 hours. So I decided to calculate the rate of waste in terms of lbs. per hour. In Room D (a section of the Salad room) I was unable to capture all of the waste because some waste was too difficult to collect in a reasonable fashion. Also, I asked for the assistance of the clean up personnel to put the waste they collected into designated bins, however, this was sometimes a lot to ask because it potentially interfered with their job. As a result, I'd expect the true average rate of waste produced by Room D to be higher than I've estimated based on the data collected. Below is a table summarizing findings.

Table 9

Room	Waste Produced	Shift Estimate
QA	70.7 ± 12 lbs./hr.	636.3 ± 108 lbs.
Room D	103.3 ± 64 lbs./hr.	927 ± 576 lbs.
Room E	54.0 ± 11.5 lbs./hr.	486 ± 103.5 lbs.
Room F	10.5 ± 5.1 lbs./hr.	94.5 ± 45.9 lbs.

On the following pages are maps showing locations and descriptions of where product is being spilled. I did not get weight measurements from the Spinach room, however, I did try to identify where and why product was being spilled.

Spill Point Losses: Location & Identification

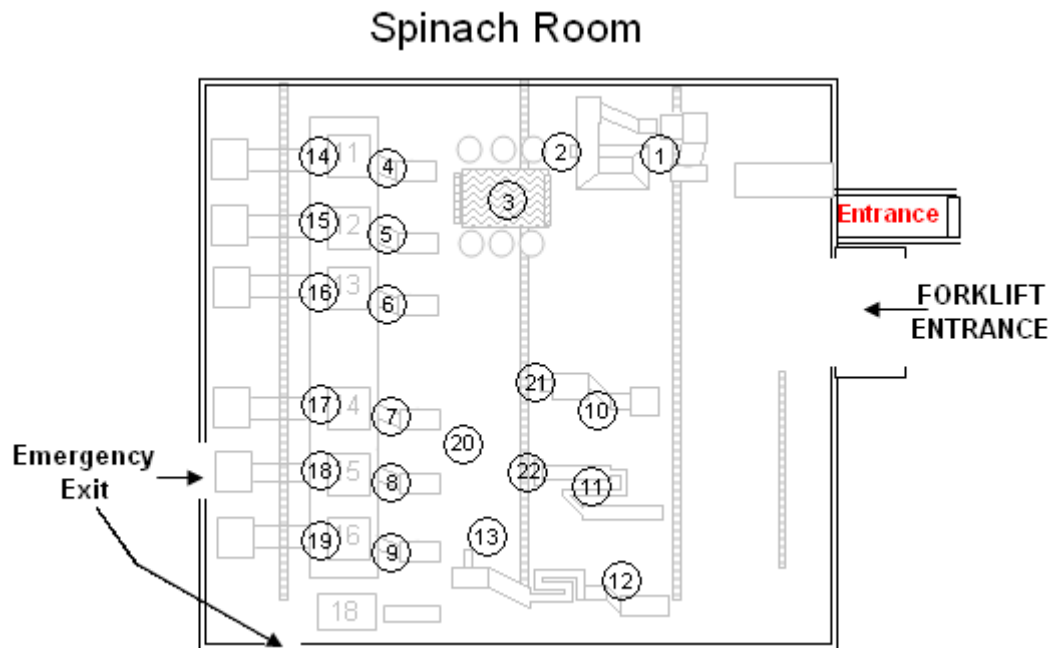


Figure 8

- 1) Product falls off line into buckets and floor.
- 2) Product gets dumped into dryer spills over/misses barrel.
- 3) Product spills out onto floor from the handling of the barrels through the dryers.
- 4) Product falls off of the ramp going to the scales and falls to floor. Space 11
- 5) Product falls off of the ramp going to the scales and falls to floor. Space 12
- 6) Product falls off of the ramp going to the scales and falls to floor. Space 13
- 7) Product falls off of the ramp going to the scales and falls to floor. Space 14
- 8) Product falls off of the ramp going to the scales and falls to floor. Space 15
- 9) Product falls off of the ramp going to the scales and falls to floor. Space 16
- 10) Product spills from the conveyor onto black buckets/floor. Spinach Line
- 11) Product spills from the conveyor onto black buckets/floor. Cauliflower Line
- 12) Product spills from the conveyor onto black buckets/floor. Broccoli Line
- 13) Product spills over/misses metal basket onto floor.
- 14) Product falls off scale and onto floor on upper deck. Space 11
- 15) Product falls off scale and onto floor on upper deck. Space 12
- 16) Product falls off scale and onto floor on upper deck. Space 13
- 17) Product falls off scale and onto floor on upper deck. Space 14
- 18) Product falls off scale and onto floor on upper deck. Space 15
- 19) Product falls off scale and onto floor on upper deck. Space 16
- 20) Product is spilled off of conveyors for lines 14-16
- 21) Spinach spills over/misses dryer barrel onto floor. Spinach Line
- 22) Cauliflower spills/misses yellow plastic baskets onto floor. Cauliflower line

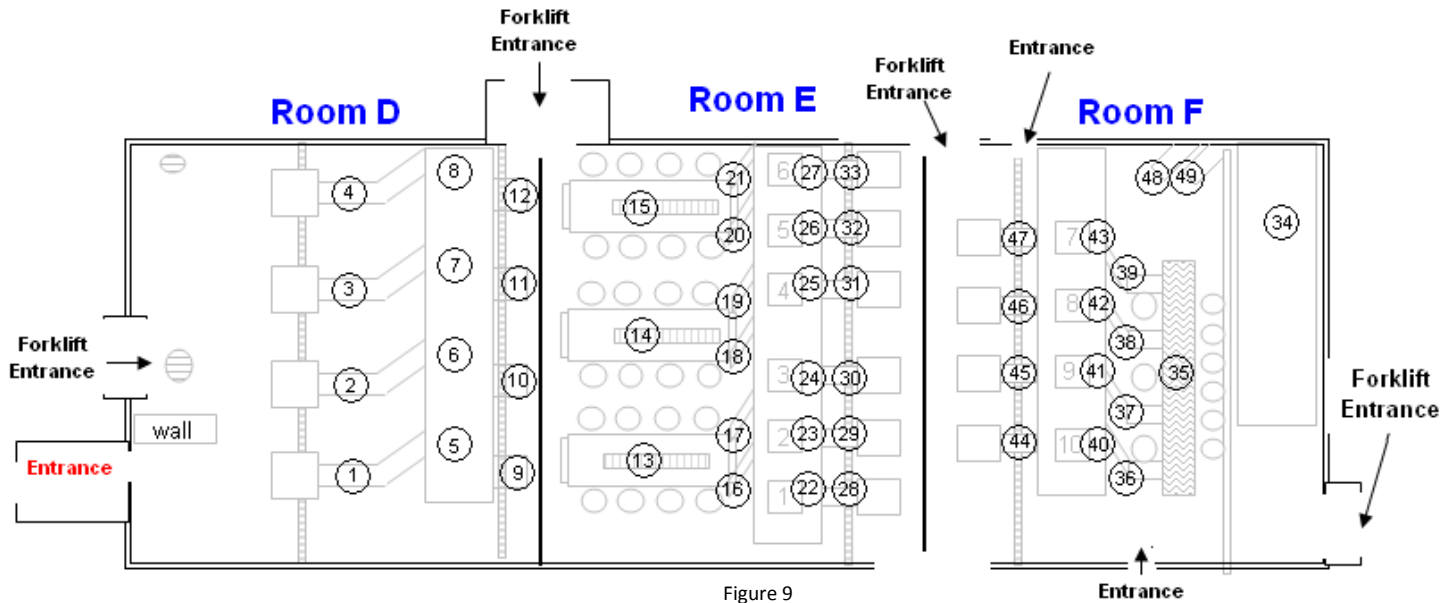


Figure 9

- 1) Product falls from conveyor onto floor & black buckets. Line 1
- 2) Product falls from conveyor onto floor & black buckets. Line 2
- 3) Product falls from conveyor onto floor & black buckets. Line 3
- 4) Product falls from conveyor onto floor & black buckets. Line 4
- 5) Product falls to the floor from the shoots on the upper deck. Line 1
- 6) Product falls to the floor from the shoots on the upper deck. Line 2
- 7) Product falls to the floor from the shoots on the upper deck. Line 3
- 8) Product falls to the floor from the shoots on the upper deck. Line 4
- 9) Product gets dumped into dryer barrels and spills over/misses barrel. Line 1
- 10) Product gets dumped into dryer barrels and spills over/misses barrel. Line 2
- 11) Product gets dumped into dryer barrels and spills over/misses barrel. Line 3
- 12) Product gets dumped into dryer barrels and spills over/misses barrel. Line 4
- 13) Product spills out onto floor from the handling of the barrels through the dryers. Spaces 1 & 2
- 14) Product spills out onto floor from the handling of the barrels through the dryers. Spaces 3 & 4
- 15) Product spills out onto floor from the handling of the barrels through the dryers. Spaces 5 & 6
- 16) Product falls off the ramp going to the scales and falls to floor. Space 1
- 17) Product falls off the ramp going to the scales and falls to floor. Space 2
- 18) Product falls off the ramp going to the scales and falls to floor. Space 3
- 19) Product falls off the ramp going to the scales and falls to floor. Space 4
- 20) Product falls off the ramp going to the scales and falls to floor. Space 5
- 21) Product falls off the ramp going to the scales and falls to floor. Space 6
- 22) Product falls off scale and onto floor on upper deck. Space 1
- 23) Product falls off scale and onto floor on upper deck. Space 2
- 24) Product falls off scale and onto floor on upper deck. Space 3
- 25) Product falls off scale and onto floor on upper deck. Space 4
- 26) Product falls off scale and onto floor on upper deck. Space 5
- 27) Product falls off scale and onto floor on upper deck. Space 6
- 28) Product from ramp/scale falls onto the top of Hayssen machine. Space 1
- 29) Product from ramp/scale falls onto the top of Hayssen machine. Space 2
- 30) Product from ramp/scale falls onto the top of Hayssen machine. Space 3
- 31) Product from ramp/scale falls onto the top of Hayssen machine. Space 4
- 32) Product from ramp/scale falls onto the top of Hayssen machine. Space 5
- 33) Product from ramp/scale falls onto the top of Hayssen machine. Space 6
- 34) Product falls from conveyor into black buckets and onto floor on upper deck.
- 35) Product spills out onto floor from the handling of the barrels through the dryers. Spaces 7-10
- 36) Product falls off the ramp going to the scales and falls to floor. Space 10
- 37) Product falls off the ramp going to the scales and falls to floor. Space 9
- 38) Product falls off the ramp going to the scales and falls to floor. Space 8
- 39) Product falls off the ramp going to the scales and falls to floor. Space 7
- 40) Product falls off scale and onto floor on upper deck. Space 10
- 41) Product falls off scale and onto floor on upper deck. Space 9
- 42) Product falls off scale and onto floor on upper deck. Space 8
- 43) Product falls off scale and onto floor on upper deck. Space 7
- 44) Product from ramp/scale falls onto the top of Hayssen machine. Space 10
- 45) Product from ramp/scale falls onto the top of Hayssen machine. Space 9
- 46) Product from ramp/scale falls onto the top of Hayssen machine. Space 8
- 47) Product from ramp/scale falls onto the top of Hayssen machine. Space 7
- 48) Product gets dumped into dryer barrels and spills over/misses barrel. Feeds spaces 7-10
- 49) Product gets dumped into dryer barrels and spills over/misses barrel. Feeds spaces 7-10

Project 10: Actual vs. Standard Yields

Goal: To assess, as directly as possible, the amount of finished product is output given a known amount of input raw product.

Sampling Method: In order to be as accurate as possible at calculating the yields, there was a fair amount of interference to the production line process. Also, when a finished product is in the form of a blend (Caesar Salad, Spring Mix, etc.) any yield calculation is confounded with how accurate and precise the salad blends actually are. Due to these facts, I only did a single simulation on Line 1 of the Salad room, and on the Two-Bin Spinach Line in the Spinach room.

Variables:

1. Number of Bins - Knowing the number of bins dumped into line is necessary to calculate the weight input.
2. Lot Number - Knowing the lot number on a bin being dumped in will give us the average bin weight for that lot, we can use this to help determine how many pounds was input.
3. Pallet Information - Knowing the information below was required to calculate an output weight:
 - Number of pallets output
 - Number of boxes in a pallet
 - Number of bags in a box
 - Weight of product in a bag

Summary of Findings:

Below are tables summarizing what was input into the production lines, what was output, and what the yields were:

No. of Bins	Lot #	lbs. per Bin	Product	Bag Weight	Bags Per Carton	No. of Cartons	No. of Pallets	Start Time	End Time	lbs. In	lbs. Out	% Yield
2	L945703	323	Spinach	2.5	4	218.25	3	12:35	1:10pm - 1:40pm	2494	2182.5	87.5%
6	L945744	308										
10	L946855	776	Lettuce	Info on Pallet Page				5:00	7:30am - 8:50am	26418	18429	69.8%
8	L946887	678										
10	L946872	664										
8	L946928	641										
2	L946953	733										

Table 10

Standard vs. Actual Yield Summary					
	lbs. IN \pm Error	lbs. OUT	% Yield \pm Error	No. Bins	Ave. Bin Wt.
Spinach	2494 \pm 272	2,182	87.5% \pm 10.7%	8	315.5
Lettuce	26,418 \pm 2,595	18,429	69.9% \pm 7.6%	38	698.4

Table 11

Note: There is a variance in bin weight for any given produce type. However, since the total Lot weight is known as well as the number of bins in a given Lot, an average bin weight can be determined. Since we don't know the weight of any specific bin being dumped onto the production line, we estimate it using the average bin weight from the Lot it came from. I looked at records of past average bin weights for Lots of Spinach and Lettuce of the months previous to determine that the average bin weight for Spinach had a standard deviation of about 34 lbs. and Lettuce about 65 lbs. Thus, since 8 bins of spinach went in, the estimated weight going in could have been off by $8 \times 34 = 272$.

Pallet Information for Lettuce Production Line

Space	Code	Label	Quantity	Bag/Carton	lbs./Bag	lbs./Pallet
1	142	RR	90	4	5	1,800
1	142	RR	90	4	5	1,800
1	142	RR	90	4	5	1,800
1	142	RR	55	4	5	1,100
1	145	RR	30	4	5	600
2	142	RR	90	4	5	1,800
2	142	RR	90	4	5	1,800
2	142	RR	46	4	5	920
2	10278	SY	35	4	5	700
2	10282	SY	72	4	5	1,440
6	10366	H=V	160	6	0.5	480
6	10366	H=V	160	6	0.5	480
6	10366	H=V	160	6	0.5	480
6	10366	H=V	160	6	0.5	480
6	10366	H=V	160	6	0.5	480
6	10366	H=V	160	6	0.5	480
6	10366	H=V	15	6	0.5	45
6	10367	F=L	120	12	0.5	720
6	10367	F=L	24	12	0.5	144

Table 11

Total Pallet lbs.out	17,549
Add 3 Barrels that went to romaine	870
Add 2 5lb. Bags which did not go to pallet	10
TOTAL LBS. OUT	18,429

Project 11: Cull Truck

Goal: To measure the amount of waste product, on average, the cull truck carries in a single load.

Sampling Method: I asked of the cull truck driver to weigh the truck before he dumped the waste as many times as he could. I used all of the weights he gave me.

Variables:

1. Truck Weight - Weight of the loaded before dumping product.

Summary of Findings:

The average weight of a single loaded truck is 23,540 lbs. and the tare weight of the cull weight is 16,780 lbs. The average weight of waste product the cull truck dumped is about 6,760 lbs. To my knowledge, how many times in a shift, or working day, the cull truck leaves to dump waste product is not kept on record. However, I was told by one of the drivers that depending on how busy the plant was he would go on 2-4 dump runs in his shift.

It is my understanding that virtually all of the food waste that results from plant operations eventually makes its way to this truck. Under that assumption, having a record of how much the truck dumps every day would be useful for double checking yield calculations. For example, if a daily yield is calculated for the plant on a given day, the loss from that yield calculation shouldn't exceed the total weight the cull truck dumped that day.

There is a problem with using the cull truck load weight, and that is that it contains a lot of water that was used to transport the waste to the shoot that dumps the product into the truck, this would somehow needed to taken into account.

Project 12: Consumption Rates

Goal: To estimate, for each production line, the rate at which raw product is consumed/input.

Sampling Method: For a period of time I would monitor how many bins went into which line, record the lot number, and whether or not the line was down or running.

Variables:

1. *Line* - Which line was inputting raw product.
2. *Number of bins/pallets* - Some lines input two bins at a time, others one, and some lines are fed by pallets.
3. *Lot Number* - This information would yield bin weights.
4. *Time In* - The time at which the product lifted into place at the begging of the line by a forklift.
5. *Time Dump* - The time at which the product began to enter the production line.
6. *Time Empty* - The time at which the bin was empty of product and ready to be removed from the line.
7. *Time Out* - The time at which the bin was removed and the line was ready to have new bins input.
8. *Wait On Product* - This was recorded as Yes or No, and it indicates whether or not the bin was waiting to be dumped onto the line because product from the last dump was in the way.

Summary of Findings:

As I was trying to come up with plan to collect data, I came up with a few different ways to calculate a rate of consumption. So, I recorded enough data to be able to calculate three different consumption rates they are listed below:

1. Pounds/hr = the time it takes for bins to be input and output.
2. Pounds/hr = how many pounds went in to a Line in the span of time I was observing.
3. Pounds/hr = how many pounds went in to a Line in the span of time I was observing only when the Line was moving (observation time - downtime).

Below is a table summarizing consumption rates by Line:

	Bins In	Pounds In	Hours Observed	Down Time Hrs.	Bins/hr	Pounds/hr	Hrs. - Downtime	Bins/hr w/o Downtime	Pounds/hr w/o Downtime	Pounds/hr Average
1	92	68,967.5	4.75	0.43	19.37	14,519.5	4.32	21.31	15,977.0	21,968.0
2	2	1,882.0	0.97	0.58	2.07	1,946.9	0.38	5.22	4,909.6	2,511.0
3	65	49,194.0	4.70	1.73	13.83	10,466.8	2.97	21.91	16,582.2	18,112.0
4	29	12,143.7	2.38	0.95	12.17	5,095.3	1.43	20.23	8,472.3	13,874.0
Broccoli	6	5,293.7	1.53		3.91	3,452.4				3,895.0
Spinach B	9	3,026.8	1.28		7.01	2,358.5				3,138.0
Spinach	24	7,777.5	1.52		15.82	5,128.0				7,007.0

Table 12

Knowledge & Hindsight

Looking back there are several lessons I learned in the way of applying statistical tools, methodology and philosophy to an industrial environment:

- Statistician vs. Client tendencies

The information I thought was the most interesting was not always that interesting to the client. That is, I didn't always fully understand what my supervisor *really* wanted to know until I presented the information he/she didn't necessarily want. Thus, I learned knowing exactly what the client wants to know and how they'll like to see that information presented is good to know *before* the data is collected and analyses are conducted.

- Sound Sampling

Statistically valid conclusions absolutely rely on sound sampling techniques. However, I learned that sacrifices must be made in order to conduct a study in a reasonable fashion. In some of the situations at RRFF it was impossible to get a random sample by myself; I had to get any data I could get my hands on, literally speaking.

- Keys to Gathering Useful Data

After almost every study I performed, I immediately wanted to redo it because I would realize at the point of data analysis, or even when presenting findings, that I had overlooked an important part of the process which impacted the unit of analysis in some important way. I learned over and over that any knowledge obtained about the process before data collection would help tenfold to collect richer, more useful, data.

Having a realistic observation platform is vital to gathering useful data. If a process outputs data at a faster rate than is possible to record, then the observation technique is flawed. I sometimes had to try twice or three times, with different observation templates/techniques in order to be able to respond to process output in a timely manner.

Part II: ASQ Quality Process Analyst Certification

An Introduction to the American Society for Quality

ASQ is a global community of experts and the leading authority on quality in all fields, organizations, and industries. As a professional association, ASQ advances the professional development, credentials, knowledge and information services, membership community, and advocacy on behalf of its more than 85,000 members worldwide.

ASQ offers many different types of quality control oriented certifications for different fields at different levels of sophistication and difficulty. Before a certification can be sought, one must qualify certain prerequisites depending on the certification.

Certified Quality Process Analyst

ASQ describes a CQPA as “a paraprofessional who, in support of and under the direction of quality engineers or supervisors, analyzes and solves quality problems and is involved in quality improvement projects. A Certified Quality Process Analyst may be a recent graduate or someone with work experience who wants to demonstrate his or her knowledge of quality tools and processes.” In order to apply for certification an applicant must have an associate’s degree and/or two years of work experience in quality control.

CQPA – Body of Knowledge

ASQ offers a guide as to what a CQPA must know in order to complete the certification exam. The following describes what must be understood:

I. Quality Basics

A. ASQ code of ethics

Identify appropriate behaviors for situations requiring ethical decisions.

B. Quality planning

Define a quality plan, understand its purpose for the organization as a whole and who in the organization contributes to its development.

C. Cost of quality (COQ)

Describe and distinguish the classic COQ categories (prevention, appraisal, internal failure, external failure) and apply COQ concepts.

D. Quality standards, requirements, and specifications

Define and distinguish between quality standards, requirements, and specifications.

E. Documentation systems

Identify and describe common elements and different types of documentation systems such as configuration management, quality manual, document control, etc.

F. Audits

1. Audit types

Define and describe various audit types: internal, external, system, product, and process.

2. Audit process

Describe various elements, including audit preparation, performance, record keeping, and closure.

3. Roles and responsibilities

Identify and define roles and responsibilities of audit participants (lead auditor, audit team member, client, and auditee).

G. Teams

1. Types of teams

Distinguish between various types of teams such as process improvement, work group, self-managed, temporary/ad hoc, cellular, etc.

2. Team-building techniques

Define basic steps in team-building such as introductory meeting for team members to share information about themselves, the use of ice-breaker activities to enhance team membership, the need for developing a common vision and agreement on team objectives, etc.

3. Roles and responsibilities

Explain the various team roles and responsibilities, such as sponsor, champion, facilitator, team leader, and team member, and responsibilities with regard to various group dynamics, such as recognizing hidden agendas, handling distractions and disruptive behavior, keeping on task, etc.

H. Training components

Define and describe methods that can be used to train individuals on new or improved procedures and processes, and use various tools to measure the effectiveness of that training, such as feedback from training sessions, end-of-course test results, on-the-job behavior or performance changes, department or area performance improvements, etc.

II. Problem Solving and Improvement

A. Basic quality tools

Select, apply, and interpret these tools: flow charts, Pareto charts, cause and effect diagrams, check sheets, scatter diagrams, and histograms.

B. Continuous improvement models

Define and explain elements of Plan-Do-Check-Act (PDCA), kaizen, and incremental and breakthrough improvement.

C. Basic quality management tools

Select and apply affinity diagrams, tree diagrams, process decision program charts, matrix diagrams, interrelationship digraphs, prioritization matrices, and activity network diagrams.

D. Project management tools

Select and interpret scheduling and monitoring tools such as Gantt charts, program evaluation and review technique (PERT), critical path method (CPM), etc.

E. Taguchi loss function

Identify and describe Taguchi concepts and techniques such as signal-to-noise ratio, controllable and uncontrollable factors, and robustness.

F. Lean

Identify and apply lean tools and processes, including set-up reduction (SUR), pull (including just-in-time (JIT) and kanban), 5S, continuous flow manufacturing (CFM), value stream, poka-yoke, and total preventive/predictive maintenance (TPM) to reduce waste in areas of cost, inventory, labor, and distance.

G. Benchmarking

Define and describe this technique and how it can be used to support best practices.

III. Data Analysis

A. Terms and definitions

1. Basic statistics

Define, compute, and interpret mean, median, mode, standard deviation, range, and variance.

2. Basic distributions

Define and explain frequency distributions (normal, binomial, Poisson, and Weibull) and the characteristics of skewed and bimodal distributions.

3. Probability

Describe and apply basic terms and concepts (independence, mutual exclusivity, etc.) and perform basic probability calculations.

4. Measurement scales

Define and apply nominal, ordinal, interval, and ratio measurement scales.

B. Data types and collection methods

1. Types of data

Identify, define, and classify continuous (variables) data and discrete (attributes) data, and identify when it is appropriate to convert attributes data to variables measures.

2. Methods for collecting data

Define and apply methods for collecting data such as using data coding, automatic gaging, etc.

C. Sampling

1. Characteristics

Identify and define sampling characteristics such as lot size, sample size, acceptance number, operating characteristic (OC) curve, etc.

2. Sampling methods

Define and distinguish between various sampling methods such as random, sequential, stratified, fixed sampling, attributes and variables sampling, etc.

D. Measurement terms

Define and distinguish between accuracy, precision, repeatability, reproducibility, bias, and linearity.

E. Statistical process control (SPC)

1. Techniques and applications

Select appropriate control charts for monitoring or analyzing various processes and explain their construction and use.

2. Control limits and specification limits

Identify and describe different uses of control limits and specification limits.

3. Variables charts

Identify, select, construct, and interpret $\bar{X} - R$ and $\bar{X} - s$ charts.

4. Attributes charts

Identify, select, construct, and interpret p, np, c, and u charts.

5. Rational subgroups

Define and describe the principles of rational subgroups.

6. Process capability measures

Define the prerequisites for measuring capability, and calculate and interpret C_p , C_{pk} , P_p , and P_{pk} in various situations.

7. PRE-control chart

Define the concept and use of PRE-control charts.

8. Common and special cause variation

Interpret various control chart patterns (runs, hugging, and trends) to determine process control, and use rules to distinguish between common cause and special cause variation.

9. Data plotting

Identify the advantages and limitations of analyzing data visually instead of numerically.

F. Regression and correlation

Describe how regression and correlation models are used for estimation and prediction.

G. Hypothesis testing

Determine and calculate confidence intervals using t tests and the z statistic, and determine whether the result is significant.

H. Design of experiments (DOE)

Define basic terms such as blocking, randomization, etc.

I. Analysis of variance (ANOVA)

Define and determine the applicability of ANOVAs.

IV. Customer-Supplier Relations

A. Internal and external customers and suppliers

Define and distinguish between internal and external customers and suppliers and their impact on products and services, and identify strategies for working with them to improve products, services, and processes.

B. Customer satisfaction analysis

Describe the different types of tools used to gather and analyze customer feedback: surveys, complaint forms, warranty analysis, quality function deployment (QFD), etc.

C. Product/process approval systems

Identify and describe how validation and qualification methods (alpha/beta testing, firstarticle, etc.) are used in new or revised products, processes, and services.

D. Reliability

Define basic concepts such as mean time to failure (MTTF), mean time between failures (MTBF), mean time between maintenance actions (MTBMA), and mean time to repair (MTTR), and identify failure models such as bathtub curve, prediction, growth, etc.

E. Supplier management

Define and describe key measures of supplier performance (quality, price, delivery, level of service, etc.) and commonly used metrics (defect rates, functional performance, timeliness, responsiveness, technical support, etc.).

F. Elements of corrective and preventive action

Identify elements of the corrective action process including containment, problem identification, root cause analysis, correction, recurrence prevention, verification and validation of effectiveness, and concepts of preventive action.

G. Material identification, status, and traceability

Describe methodologies used for material identification and conformance status. Apply various methods of identifying and segregating nonconforming materials, and describe the requirements for preserving the identity of a product and its origin.

Test Preparation

The ASQ website offers many tools to help guide an applicant through the studying process. I took several practice exams and made sure to cover each outlined point in the body of knowledge. I spent roughly 25-30 hours cumulatively studying for the certification exam over the course of about a month.

Several concepts outlined in the body of knowledge (BoK) were reinforced by my experience at RRF. The idea of team structure, purpose, and formation was already familiar to me from my internship experience so I was able to better understand those concepts. Also, the BoK describes documentation systems as a key concept in a fully functioning and effective quality control system, I found this to fall right in line with my work experience and the challenges I faced there. In general, many of the non-statistical components in the BoK for the CQPA I was genuinely exposed to in my work experience.

Examination & Results

The examination took place at a PG&E satellite office at the southern edge of San Luis Obispo, near HWY 101. I was allotted four hours to complete the certification exam, allowed a scientific calculator, and was permitted to have a reference sheet.

Approximately four weeks after I took the examination I received an official certificate for the CQPA position.

On the following page are the contents of the press release provided by ASQ.



Contact: Lynda Nicely
800-248-1946, x 7587
lnicely@asq.org

FOR IMMEDIATE RELEASE

Huey D. Dodson Receives ASQ-Certified Quality Process Analyst

Milwaukee, WI, February 26, 2010 — The Certification Board of ASQ (American Society for Quality) is pleased to announce that Huey D. Dodson has completed the requirements to be named an ASQ-Certified Quality Process Analyst (ASQ CQPA). As such, Huey D. Dodson has reached a significant level of professional recognition, indicating a proficiency in and a comprehension of basic quality principles and techniques. Individuals who earn this certification are allowed to use "ASQ CQPA" on their business cards and professional correspondence.

"ASQ provides certification as a way to provide formal recognition to professionals who have demonstrated an understanding of, and a commitment to, quality techniques and practices in their job and career," explains Peter Andres, ASQ president. "This is a great accomplishment and, although not a formal registration or licensure, it represents a high level of peer recognition."

A Certified Quality Process Analyst (CQPA) selects and uses quality tools in a variety of problem-solving situations, creates and monitors control charts and other statistical process control (SPC) tools, supports customer-supplier relations, and participates in continuous improvement initiatives on quality teams or under the direction of a quality engineer or supervisor.

Since 1968, when the first ASQ certification examination was given, more than 163,000 individuals have taken the path to reaching their goal of becoming ASQ-Certified in their field or profession, including many of who have attained more than one designation. To learn more about ASQ's Certified Quality Process Analyst program, visit <http://www.asq.org/certification/quality-process-analyst/>.

ASQ, www.asq.org, has been the world's leading authority on quality for more than 60 years. With more than 85,000 individual and organizational members, the professional association advances learning, quality improvement and knowledge exchange to improve business results and to create better workplaces and communities worldwide. As champion of the quality movement, ASQ offers technologies, concepts, tools and training to quality professionals, quality practitioners and everyday consumers. ASQ has been the sole administrator of the prestigious Malcolm Baldrige National Quality Award since 1991. Headquartered in Milwaukee, Wis., ASQ is a founding sponsor of the American Customer Satisfaction Index (ACSI).

#